

**Transactions of the VŠB – Technical University of Ostrava, Mechanical Series**  
No. 2, 2009, vol. LV,  
article No. 1697

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**OPERATORS CONTROL OF RAILWAY MODEL**

**OPERÁTORSKÉ ŘÍZENÍ MODELOVÉHO KOLEJIŠTĚ**

**Abstract**

This article describes digital control of trains on a railway model and it implements option of monitoring and controlling of model from graphical interface by operator. Constituent components and their function, control system and its possibilities, a software applications needed for practical realization of assignment are described. On the base of knowledge of safe railway traffic [5] is created program which controls movement of trains, setting of train ways and signal-safe components on the model [7]. Next is described graphical interface which shows situation on railway and which allows to operator to set train ways and control movement of train. A new way of trains movement was created.

**Abstrakt**

Článek popisuje číslicové řízení vlaků na modelu kolejiště a možnost implementace monitorování a řízení modelu operátorem prostřednictvím grafického rozhraní. Jsou rozebrány možnosti jednotlivých komponent a jejich funkce, řídicí systém a jeho možnosti, softwarové aplikace potřebné pro praktickou realizaci a jejich význam. Na základě bezpečnostních předpisů pro provoz na železnici [5] je vytvořen program, který řídí pohyb vlaků, nastavuje vlakové cesty a bezpečnostní signalizační zařízení na modelu [7]. Dále je popsáno grafické rozhraní, které zobrazuje situaci na železnici a umožňuje operátorovi nastavovat vlakové cesty a řídit pohyb vlaků. Byl vytvořen nový způsob řízení pohybu vlaků.

**1 INTRODUCTION**

The model yard is made-up from components for railways of size TT that means we work with the model in gauge 1:120 with track gauge 12 millimetres. The model is composed from series of functional elements (points, a marker, a rail-pike etc.), but also from many decorative components (trees, buildings, a tunnel, etc.). The complex is put into the protective case, which saves its parts before damage (see Fig. 1). The railway model is usable for railway management courses for training students in field of control.

**2 RAILROAD TRACKING CONTROL**

It is necessary to place a station interlocking plant on the railway system (a technical mean, working for enhancement of safety in service by limitation of dependence on human operator). It provides partly preparation of route (train or shift) and at the same time a safe route of the train or shifted part in (terminal area). The safe route – we mean e.g. to preclude changeover points below ridden train, to preclude realization of clashing way, to reserve a side protection of the ridden train, actively (rearrangement of points into diversion position) or passively (by the help of the marker) and

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so on. Enhancement of serviceability, level of management and general utility fund are the next factors for setting of the safety technique [2].



**Fig. 1** View to model yard

## **2.1 Building of given route**

At demand on given route it is needed to choose the kind, the direction, the beginning and the end of it! This way determination is used near the system with associated formation points (the way „from where to where“). At the formation of routing the points must be rearranged into requisite position, namely on condition that they are not closed in the other routing and that objective section is free. At the same time the position of the one from the verboten routing must be excluded. Then, if their definitive position corresponds to the elected route and the all safety conditions are completed, their ending is done. Licensing signal lights up after the check of conditions for lighted marker and the check of its lights. By the inputs of train front behind the marker with allowable statement this must be changed into the signal „stop“. At the shifted routes the marker „shift possible“ changes into „shift forbidden“ by vacation of insulated section before the marker until the vacation of the section behind marker. Close of points annuls either step by step the way, how the given routing is ridden pursuant to slack section, or after the running through the whole train route.

At any time there must by possibility to cancel the route which was not driven through. That means there has to be possibility to free a point by the separate operation. Before that the signalling on licensing statement number must be changed in statement „stop“ or „shift forbidden“. Depending on the train position the time out is included.

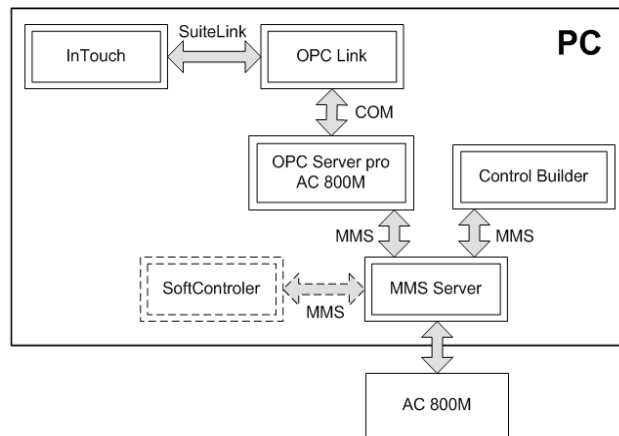
## **2.2 Application software**

For the realization of this task we needed to install needed applications and on-configure all communication boundary-lines in one PC correctly. For notions, how single programs communicate together, the graphic model was created (see Fig. 2).

### Description of each applications:

- PLC Control Builder AC 800M 4.1.0 (ABB) - PLC Control Builder is programming implement designed for production of programmatic solutions for control using modular PLC AC 800M.

- OPC (OLE for Process Control) Server 4.1.0 (ABB) - OPC server for PLC AC 800M serves for reading run-time data and/or alarm and events [1].
- MMS Server 4.1 (ABB) - it provides transport of data in net.
- SoftController 4.1 (ABB) - it is a programmatic utility providing from-malinger the application created by the help of PLC Control Builder without connection to PLC.
- OPC Link 8.0 (Wonderware) - OPC Link connects application InTouch with OPC Server. It serves as a convertor providing transmission of OPC record on DDE, FastDDE or SuiteLink record and back.
- InTouch 9.5 (Wonderware) - InTouch is SCADA/HMI application of data processing. It makes possible to obtain data from distant arrangements (PLC, intelligent sensors, etc.) and to display them in right forms to the operator.



**Fig. 2 Applications structure**

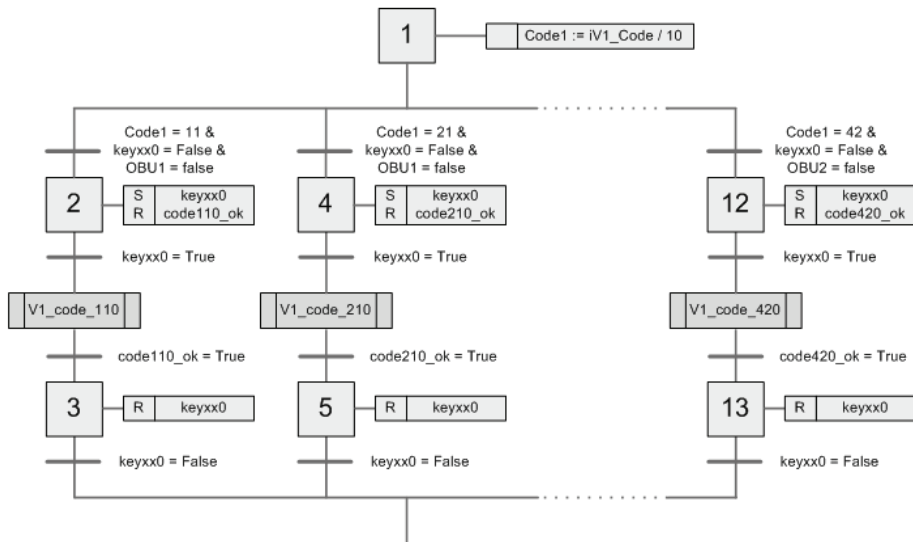
### 3 NEW CREATED SOFTWARE

System management on the yard requires a work in two applications. One of them serves for creation of program for PLC, driving operation on the yard, and the second one provides to create graphic boundary-line for monitoring and operating [6].

#### 3.1 PLC software

This program is created in application Control Builder by the help of graphic programming language SFC. It directs a movement of the trains on the yard, rebuilding of points and settings of movement signalling. Resultant program is then recorded into PLC, which is connected to the model of the railway [8].

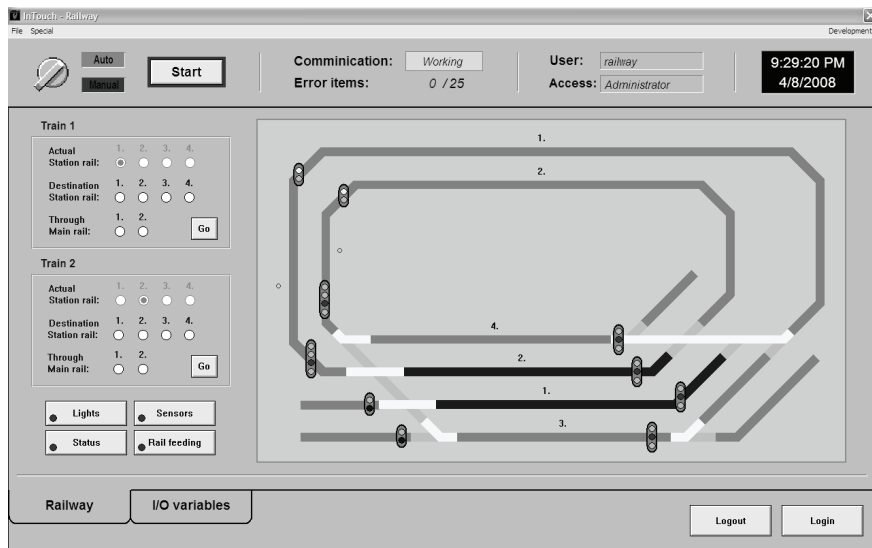
Function of this program is described by GRAFCET method (Graphe Fonctionnel de Connexion Etapes Transitions) [3] that is directed on program specification for PLC. Beyond it clearly defines inputs, exits and their relation. Example of sub-program for control of train departure from the station is shown in Fig. 3.



**Fig. 3** Sub-program Departure from station

### 3.2 Graphical interface

The graphic boundary-line in application InTouch [4] was formed for monitoring and operating of the trains on the yard. From this environment it is possible to start a programme in chosen modulus, and to monitor the state of all controlled elements on the model, to choose train routes and to malingner signals from the sensors.



**Fig. 4** InTouch – the main window of the application

The main application window (see Fig. 4) is created by three parts, they give us information about the state on the all model yard. Upside part has rather an informative function, but it contains also a button start/stop and switch to choose a module. Then we can find status information about the state of communication between programme InTouch and PLC. In case of a problem with variables it

gives information about a number of mistaken I/O variables. Next information refers to login and also date and time does not miss.

Middle part shows the model railway itself. On the left side we can see a window for choosing a train ways to both trains and buttons providing to display or hide additional information like state of the semaphore for opposite direction, information about the train on engaged segments, visualization of sensors and display of power supply track.

Lower part of the window is created by turn-ups, providing to switch between windows and buttons for log-in and log-out.

After starting of application animated elements start to work the way, how they are setting in initialising step of supervisor for PLC – marker with setting to signal „Stop“, power supply track switches off (except power supply for point sections), engaged sections are set. If it does not work like that, then the problem is in communication with PLC that would initialize automatically for setting up of runtime mode in program InTouch. In problematic cases it is possible to stimulate communication from offering moulding (Special / Reinitialize I/O / Reinitialize all).

The program starts by selection of modus and by a click on the button Start from upper offering of runtime windows (see Fig. 5). In the main window we can notice that communication between PC and PLC works right. A window informing about login shows that user of „railway“ with rights of „Administrator“ is logged- in on the computer. Log-in as „Administrator“ serves for declassifying of buttons illustrating sensors. They make it possible to send signals into PLC, and thereby to malingering a passage of the train whereupon the given sensor, and to test the created program without log-in to the real model.

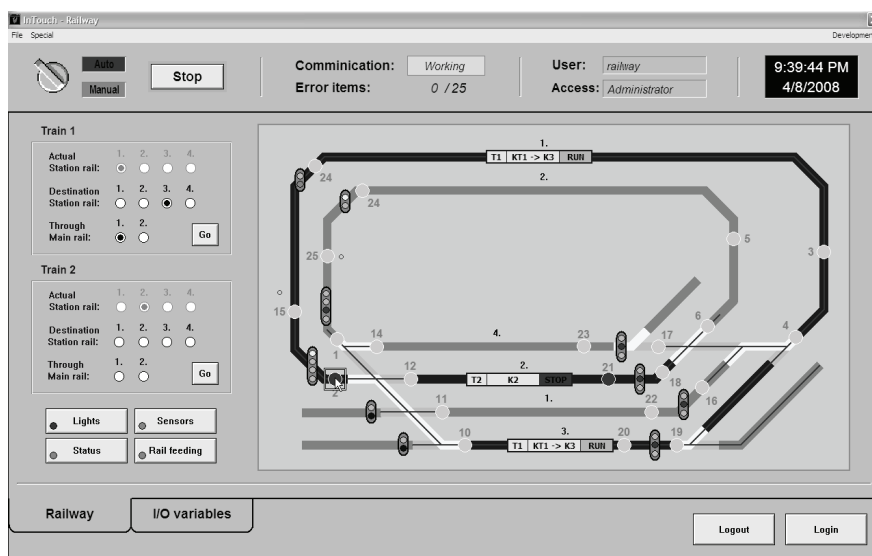


Fig. 5 InTouch – Run-time mode

The main application shows the model yard with all its operated elements, like e.g. . Signals, points and power supply sections. In the picture we can notice next information, which refers to currently engaged sections (in red engrained track sections). On engaged segments informative blocks are represented, informing about number, route and state of the train, which is on the given section. (E.g. Informative block of a wide track 1 announces that the train n.1 is riding just on it and its actual position is between the wide track 1 and station track 3. Then the informative block of station track 2 gives the information about train n.2, which is standing on this track.).

## 4 CONCLUSIONS

This contribution is aimed to make-up a program for PLC, and by the help of it we can operate a movement of two trains on the yard, when by the help of the graphic boundary-line we choose from where to where the train has to go. The paper describes a solution of linking-up of single elements of the model, the way of the connection with hardware platform AC 800M and software realization, which provides a communicating among all the used applications.

In the paper the program built-up for PLC is described, which makes it possible to control a movement of the trains on the yard, there is possibility to work on two modes – an automatic one and a manual one. The automatic mode is chosen by itself after the program starts in PLC, and after the switch is into the start position on the model, setting-up movement of the trains starts to work on the yard. The manual mode is possible to start only at initiation of InTouch application in mode Run-time. This mode makes it possible to choose a train route, up which the train has to go, and thereby to control the events on the yard.

The solution of the graphic environment in the program InTouch allows us not only to adjust the train routes and to monitor the state of all elements on the model, but it provides to malingering a movement of the train in case, that we're not connected to the real PLC. After log-in as the administrator we have a possibility to malingering signals from the sensors, and to check it e.g. the rightness of the created program.

The paper was created with help of Institutional Research of Department of Control Systems and Instrumentation, VŠB – Technical University of Ostrava.

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